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Inventor: Timothy Baker

ACCESSORY ATTACHMENT FOR ROTARY HAND TOOLS

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ACCESSORY ATTACHMENT FOR ROTARY HAND TOOLS

1 Background Of The Invention

2 The present invention relates to attachments for rotary hand tools, and more
3 specifically relates to alignment of attachments to rotary hand tools.

4 Small rotary hand tools that have a generally cylindrical housing or case
5 have been marketed for many years for use in carrying out various woodworking
6 and metal working tasks by hobbyists as well as commercial artisans. Such rotary
7 hand tools generally have a motor unit with a rotary output shaft extending from
8 the nose end and often have a nose portion that is configured to connect to various
9 accessories or attachments. Some of these rotary hand tools are somewhat larger
10 and more powerful and are known in the building trade as spiral saws that use a
11 side cutting bit to penetrate and to rapidly cut holes for electrical outlets, light
12 fixtures and switches and the like in dry wall. Because these tools are quite
13 powerful even though they are relatively small, they are convenient to use on a
14 jobsite or just about anywhere else where a source of AC power is available.

15 There has been continued innovation and improvement in the design of
16 accessories for such hand tools, particularly with regard to the attachment of those

1 accessories to a corresponding hand tool. Examples of those attachments are those
2 produced under the Skil® and Bosch® brands by the Robert Bosch Tool
3 Corporation of Mt. Prospect, Illinois.

4 During use, it is important that accessories connecting directly to an output
5 shaft of the rotary hand tool maintain a high level of alignment with respect to the
6 motor output shaft axis, particularly where the rotational speed is high. However,
7 conventional methods of coupling fail to provide sufficient precision alignment of
8 the output axis of a rotary hand tool and the corresponding input axis of a rotary
9 hand tool attachment, without simultaneously compromising the relative rigidity
10 or tolerance of the coupling. Thus, during operation, misalignment frequently
11 results in undesirable vibration. In addition, the heat generated from such
12 vibration can eventually cause the attachment to weld itself to the rotary hand tool.

Summary Of The Invention

14 The present invention is related to attachments for rotary hand tools, and
15 more specifically relates to attachments that may be quickly and securely attached
16 and detached from the rotary hand tool, and that optimizes the alignment of the
17 output axis of the rotary hand tool and the corresponding input axis of the
18 attachment.

19 The preferred embodiment of a rotary hand tool attachment is intended for
20 coupling to a rotary power hand tool of the type that has a housing with a
21 substantially cylindrical nose portion and a motor having an output shaft with a

1 mounting coupling for receiving a drive shaft extending forwardly therefrom. The
2 attachment includes a housing having an output shaft configured to drive a rotating
3 tool, and an input shaft configured to couple with the drive shaft so that the motor
4 output shaft, drive shaft and input shaft are aligned on a common axis. The
5 housing also includes a mounting collar with a substantially cylindrical inside
6 surface that is sized to slidably and snugly engage the nose portion. Additionally,
7 a thin annular cylindrical layer of resilient material is disposed between the
8 cylindrical inside surface of the housing and the nose portion.

Brief Description Of The Drawings

10 FIGURE 1 is a front perspective view of the preferred embodiment of the
11 accessory attachment.

12 FIG. 2 is a rear perspective view of the accessory attachment illustrated in
13 FIG. 1.

14 FIG. 3 is a side view of the accessory attachment illustrated in FIG. 1
15 shown partially in cross-section through the middle of the attachment, and shown
16 together with a power hand tool to which the accessory attachment can be coupled.

17 FIG. 4 is an exploded view showing each half of the accessory attachment
18 illustrated in FIG. 1.

19 FIG. 5 is an end view of the input shaft of the accessory attachment
20 illustrated in FIG. 1.

Detailed Description Of The Invention

2 Rotary hand tools that operate at high rates of rotation are susceptible to
3 misalignment of the tool output shaft with the input shaft of any accessory
4 attachment that may be coupled to the tool. Such misalignment creates
5 undesirable vibration that is not only disruptive to the user, but which can
6 ultimately result in damage to the rotary hand tool and/or the accessory
7 attachment. For example, when accessory attachments are rotating at high RPM,
8 the vibration due to imperfect alignment may actually cause the attachment to
9 weld itself to the rotary hand tool. Thus, maintaining proper alignment of the tool
10 output shaft and the accessory attachment input shaft is advantageous in that it
11 prevents unwanted vibration and possible resulting damage.

12 Spiral saws are a typical example of a rotary hand tool that operates at high
13 rates of rotation, frequently operating at 35,000 RPM. Typically, “dedicated”
14 rotary power hand tools, or tools having a single specialized function, include a
15 housing that encloses an electric motor that is coupled to a mechanism that
16 provides the unique function of the tool. A spiral saw, however, typically includes
17 a housing that encloses only a motor. This simplicity affords the spiral saw
18 tremendous versatility, because it is capable of performing a multitude of
19 additional tasks depending on the particular accessory attachment that is attached
20 to the spiral saw.

21 However, dedicated rotary power hand tools have the benefit of gear or
22 other mechanisms driven directly by the motor to be included within the main

1 body of the tool, which provides for a single, solid, smooth-running unit because
2 the functional mechanisms can be coupled directly and permanently to the motor.
3 Conversely, spiral saws must utilize non-permanent, relatively non-rigid
4 connections between the tool body and the accessory attachment. Moreover, the
5 coupling elements of the spiral saw and the accessory attachment previously must
6 been manufactured to very high tolerances to ensure accurate axial alignment.

7 However, unlike many prior tool, the preferred embodiment of the present
8 invention provides an inexpensive, yet highly effective attachment mechanism that
9 is capable of providing precision alignment between the output shaft of a rotary
10 power hand tool, such as a spiral saw, and the input shaft of an accessory
11 attachment.

12 Turning now to FIGs. 1-3, the accessory attachment, designated generally
13 at 10, may be used to couple a multitude of different rotating tools to the rotary
14 power hand tool. For example, the rotating tool may be a dust extractor, a circular
15 saw or a router. While it is understood that a variety of accessory attachments
16 may be coupled to the rotary power hand tool, for purposes of illustration only, the
17 accessory attachment 10 will be shown coupled to a right angle circular saw
18 attachment.

19 Moreover, the rotary power hand tool with which the accessory attachment
20 10 may be coupled may include a variety of tools, and is particularly useful in
21 tools, which rotate at relatively high speeds. For purposes of illustration, a spiral

1 saw, designated generally at 12, is shown as the rotary power hand tool to which
2 the accessory attachment 10 is coupled.

3 The accessory attachment 10 includes a housing 14 preferably composed of
4 a rugged, impact resistant plastic material and having an output shaft 16
5 configured to drive a rotating tool, such as a circular saw 18. For example, the
6 housing 14 may include a nylon, ABS, or polypropylene, and preferably includes a
7 33% glass-filled nylon. Preferably, the accessory attachment 10 includes two
8 halves that matingly engage one another in a clamshell engagement to form a
9 single housing 14. The housing 14 also includes a generally hollow front portion
10 20 having a circular opening 22 and a generally cylindrical wall 24 at an opposite
11 end thereof. Disposed within the wall 24 is an opening through which an input
12 shaft 26 of the accessory attachment 10 extends.

13 The accessory attachment 10 illustrated in FIG. 1 is a right angle
14 attachment in that the orientation of the input shaft 26 of the accessory attachment
15 is generally perpendicular to the orientation of the output shaft 16 of the spiral saw
16 12. Thus, the accessory attachment 10 includes a bevel gear set 27 to
17 communicate rotational torque from the input shaft 26 to the output shaft 16.
18 Coupled to the output shaft 16 is the exemplary circular saw blade 18.

19 The spiral saw 12 includes a generally cylindrical housing 28 preferably
20 made of a rugged, impact resistant plastic material and having a substantially
21 cylindrical nose portion 30. Enclosed within the housing 28 is a motor (not
22 shown) that drives a motor output shaft 32 that extends through and from the nose

1 portion 30. A detachable handle 34 is also optionally provided with the spiral saw
2 12.

3 The circular opening 22 of the accessory attachment 10 has a predetermined
4 inside diameter that is slightly smaller than the nose portion 30 of the spiral saw
5 12 so that the nose portion 30 can snugly fit within the circular opening 22 during
6 coupling of the accessory attachment to the spiral saw. Typically, in the absence
7 of the accessory attachment 10, a spiral cutting bit (not shown) or other bit or tool
8 can be coupled to a chuck or the like attached to the motor output shaft 32.
9 However, when the accessory attachment 10 is to be coupled to the spiral saw 12,
10 coupling means are provided to transmit the rotational torque from the output shaft
11 of the spiral saw to the input shaft 26 of the accessory attachment, and then to
12 the output shaft 16 of the accessory attachment.

13 Coupling of the output shaft 32 of the spiral saw 12 to the input shaft 26 of
14 accessory attachment 10 may be accomplished in a variety of ways. For example,
15 a drive nut or a chuck 36 (as shown) may be coupled to the output shaft 32. The
16 input shaft 26 of the accessory attachment preferably has a square or other
17 noncircular opening so that an intermediate drive shaft having a complementary
18 configured outer end can be inserted into the opening and its opposite end
19 mounted in the chuck 36. In this manner, the spiral saw 12 and accessory
20 attachment 10 are mechanically coupled, with the motor (not shown), output shaft
21 32 of the spiral saw, and input shaft 26 of the accessory attachment properly
22 aligned.

1 However, without additional support, maintaining the alignment during
2 operation of the spiral saw 12 is very difficult if not impossible. For this reason,
3 the accessory attachment 10 includes features for maintaining proper alignment.
4 The front portion 20 includes a mounting collar 40 having first and second annular
5 flanges 42, 44 separated by an annular groove 46. An outer wall 48 defines an
6 outside wall of the first annular flange 42. A pair of diametrically opposed
7 longitudinal slots 50, 52 extend through the width of the annular groove 46 and the
8 outer wall 48.

9 On at least a portion of an inside diameter of the mounting collar 40 is a
10 retention ring 54, which is preferably a thin annular cylindrical layer of resilient
11 material that is preferably molded onto the inside diameter of the mounting collar.
12 The resilient material of the retention ring 54 is preferably a thermoplastic
13 elastomer (TPE) such as santoprene, and may also include a variety of additional
14 fluoroelastomers as well. The retention ring 54 also has a predetermined
15 thickness, preferably in the range of 0.6mm to 2.0mm.

16 To ensure that the retention ring 54 is sized and configured according to the
17 preferred embodiment, the retention ring is preferably molded on the inside
18 surface of the mounting collar 40 via injection molding. Molding the retention
19 ring 54 onto the mounting collar 40 has the added benefit of permanently fusing
20 the retention ring to the mounting collar because the TPE chemically bonds to the
21 mounting collar 40. An annular retention rib 56 is provided at an inwardly spaced
22 location relative to the outer wall 48 of the inside diameter of the mounting collar

1 40 to facilitate the injection molding process. The retention rib 56 defines a
2 bottom edge of the retention ring 54, and is configured within the accessory
3 attachment 10 prior to molding of the retention ring. Thus, the retention rib 56
4 forms a barrier during the molding process so that the retention ring 54 is confined
5 to the inside diameter of the mounting collar 40.

6 Because of the properties inherent to the TPE, the retention ring 54
7 provides a resilient cushion between accessory attachment 10 and the nose portion
8 30 of the spiral saw 12. The nose portion 30 is sized and configured to snugly fit
9 in the circular opening 22 and the mounting collar 40, but in the absence of the
10 retention ring 54, there is little to absorb the vibration of the spiral saw 12 during
11 use, and there is little to prevent the rotation of the nose portion 30 relative to the
12 mounting collar 40 in response to vibration. However, the provision of the
13 retention ring addresses both problems by absorbing energy from vibration as it is
14 emitted from the spiral saw 12 and by frictionally engaging the nose portion 30 to
15 prevent rotation of the nose portion 30 within the mounting collar 40. Thus, once
16 the accessory attachment 10 is coupled to the spiral saw 12, the retention ring
17 maintains alignment between an axis of the output shaft 32 of the spiral saw and a
18 corresponding axis of the input shaft 26. Additionally, owing to its resilient
19 properties, the retention ring 54 reduces the need for close manufacturing
20 tolerances of the coupling elements by providing axial and angular “play,” or
21 additional tolerance, without compromising the rigidity of the coupling.

1 Once aligned, an elongated annular band and locking clamp 58 is
2 preferably coupled to the mounting collar 40 to maintain the positional alignment
3 and engagement of the nose portion 30 within the mounting collar. The locking
4 clamp 58 preferably has a generally circular circumference, and in a locked
5 position, has a circumference that is only slightly larger than that of the annular
6 groove 46 and smaller than that of the annular flanges 42, 44. Additionally, the
7 band and locking clamp 58 is preferably sized and configured to nest between the
8 annular flanges 42, 44. Thus, when coupled to the mounting collar 40, the band
9 and locking clamp 58 is preferably disposed between the annular flanges and in
10 abutment with a top surface of the annular groove 46.

11 While the band and locking clamp 58 may include a variety of locking
12 mechanisms, the preferred locking clamp includes an open position and the locked
13 position. In the open position, the band and locking clamp 58 has a circular
14 circumference that is larger than that of both the annular groove 46 and the annular
15 flanges 42, 44 so that the mounting collar 40 may be inserted in the locking collar.
16 Once positioned around the mounting collar 40, the length of the band and locking
17 clamp 58 is decreased by manipulating the clamp to a closed position. To prevent
18 inadvertent opening and unlocking of the clamp, a radial tab 60 is preferably
19 provided around a portion of the annular flange 44 that coincides with the location
20 of the clamp 58 in the closed position. This prevents the user's hand from
21 accidentally contacting an opening the clamp 58, which instead requires deliberate
22 effort to open.

1 While various embodiments of the present invention have been
2 shown and described, it should be understood that other modifications,
3 substitutions and alternatives are apparent to one of ordinary skill in the art. Such
4 modifications, substitutions and alternatives can be made without departing from
5 the spirit and scope of the invention, which should be determined from the
6 appended claims.

7 Various features of the invention are set forth in the following claims.